Sov.

CURRENT SUMMARY OF RESEARCH ON THE SOLAR ATMOSPHERE

by A.B. Severny (unpublished)

The most important relates to the further spectroscopic investigations of the fine structure of emission in active regions (flares, faculae), revealed by A.B. Severny in 1954, (see Trans.A.U.I. ,Astron.Journ.USSR 33,74, 1956; Izvest. (Publ.) Crim.astroph.obs. 16 , 1956; Public. of the Sympos. on Electron. Phen. in Cosm. Phys., Stokholm, 1956). The new big solar tower telescope (Publ.Crim.astrop.obs. 15, 1956) with large spectrograph (dispersion 4-7mm per 1Å and resolving power 400000 -600000) was used for this work. More than 50 spectra were analysed (Publ.Crim.astr.obs. 17, 1957). The most striking appearance of brilliant and extensive (up to 15 Å) wings at the sides of undisturbed lines (called "moustashes" and observed at Balmer lines, Ca^+- lines, Mg) and some other) is allways accompanied by continuous emission. The size of the grains of this peculiar emission is 0".4, their life time is from 1.^{m}5 up to 80^m. The measurement of the shift of the lines within these grains show their upward motion with the velocities up to 5km/sec. The fact that blue wing of moustashes is brighter and broader than the red one (independently on the position on the disk) and some other facts such as the peak-like form of the wings, the bias of moustashes in the plane of dispersion indicate the process similar to an explosion with the velocities of particles up to 1000 km/sec; neither Stark, nor natural damping, but violent macroscopic motions was shown to be responsible for the broadening of this emission. The photometric study of the continuous emission showed that it is liberated in optically thin grains which are usually located at depthes $0.01 < \bar{\tau} < 0.6$ (Severny ibid.,Khokhlova, same Publ.19 in press) and distributed across the spectrum as if it were caused by relativistic electrons with the differential spectrum of energies $dN(E) \propto E^{-1}$. The same distribution was shown to take place in the continuous spectrum of several flares (Publ.Crim.astr.obs., 19 in press). The measurements showed that the polarisation of this emission is slightly different from that of undisturbed adjacent continuum.

The most extensive wings of Balmer lines in great flares are formed out of a cluster of moustashes.

The grains of this nonstationary emission liberate the energy in amounts of some hundreds ergs/cm^{3}sec.-comparable with the thermonuclear generation of energy. The strengthening of the line ₹6561, 105 (the blend of water vapour and D_α - line) in 1,3 times (in the main) was found in spectra 28 moustashes and flares indicating the strengthening of D_α line in these formations. In several cases of extremely low water vapour content the evidence for the line \6561,09 of D_α was found in active sun spots. There is possibly a source of neutrons in these grains (Publ. Crim. obs. 17, 1957, Astron. Journ. USSR, 34, N.3, 1957).

The hydrogen high dispersion spectra of several flares were examined with the following results (Severny,A., Severny and Kasachevskaja, Publ.Crim.obs. 19, in press) 1) The emission of all Balmer lines (H_α - H_6) are broadened mainly by Stark-effect provided N $\sim 10^{15}$-10^{16}, P_e-25-50 bars, Tkin = 10000 °K, 2) The Balmer - decrement in flares disagrees with that for the process of recombinations. 3) All possible processes of excitation and ionisation were considered. The population of low levels ($n \leq 3$-4) is nearly stationary and determined by flares own field of radiation; for higher levels ($n \geq 4$-5) the population is gouverned by the processes of collisional excitation and ionization. The cooling of electron gas by these processes in 50 rapid (small fraction of sec.) that there should exsist some unknown source capable to maintain the nonstationary energy liberation (500 ergs/sec.cm^3) during the life time of flare. 4) The consideration showed that neither electromagnetic heating nor the heating by coronal matter could be responsible for this energy production, but high-energy particles (10^9eV) with number density 10^5cm^{-3}. Fermis mechanism of acceleration of particles was shown hardly possible in flares. N.A.Savich (Publ.Crim. obs. 19, in press) carried out very extensive comparison of min records for different ionospheric layers with H_α - intensity curves of flares. He found the most ionospheric response in E and D - layer, and qualitatively this can be explained by

his analyzis it accept that the intensity of ultraviolet radiation in a big flare increases in 10^5 times as compared with undisturbed chromosphere. This favours the hypothesis that some other ageney (for instance x-pays) may be responsible for the behaviour of these layers during flare event. (The ionospheric records were obtained with panoramic device described in the same Publ. 17, 1957).

The unusual behaviour of earth magnetic field, ionospheric layers and atmospheric during the great flare of Aug.31,1956 was reported by Crimean observatory observers in Bull. Solar Data N.4,1957. This flare was accompanied by more than 10^4 fold increase of radioemission above the normal level and by very pronounced D_3 - absorption in this spectra.

V.Bumba[x)] (Publ. Crim.obs. 19, in press) comparing the location of flares on H_α- Crimean observatory films with the measurements of nearly sunspot magnetic fields (see report to the Comm.12) found to that brightest part of flares coincide with the loci of change of magnetic polarity.

S.I.Gapasuk) measured the motions in the great flare Aug. 31, 1956 and found that the motions of luminous fronts are very similar to that in the case of shock-waves (the same dependence of the depth of the front on the velocity etc. (Publ.Crim. obs. 19, in press).

V.Khokhlova (Publ.Crim.obs. 17, 1957) measured the Doppler shifts of K_2 and K_3 emission in flocculae on high dispersion spectra with the results that there is an outward radial motion with the velocities up to 2 km/sec., 2) there are pronounced tangential motions in floculae with velocities up to 6-8 km/sec indicating the process similar to expansion. In undesturbed chromosphere there exist regular upward motions of K_2- layer with a mean velocity about 1.5 km/sec and downward motions of K_3 - layer with a mean velocity of 0.8 km/sec

A.B.Mustel and T.T.Tsap (Publ.Crim.obs. 17, 1957) carried out the detailed measurements of the intensity distribution on H and K - spectroheliograms (obtained simultaneously) and found close correspondence between both of them especially in the regions occupied by flocculae. This indicates that one and the same source of excitation energy is acting, possibly - the heating by coronal matter.

The same authors (Publ.Crim.obs. 16, 1956) measured the profiles of infrared Ca^+-triplet λ8500 in flocculae and evaluated the flocculer energy excess. They found strong self absorption in these lines.

A.B.Severny, S.I.Gapasuk and I.G.Moissejev (the same Publ. 15, 1955; 17, 1957) found close correspondence between brightening of flocculae was well as the appearence of surges and eruptive filaments on the disk, and the isolated bursts and other events in the radioemission in 1,5m.wavelength. (The measurements were based on the moving films obtained with 0-5Å H_α - narrow band filter and records of radioemission with the radio-telescope described by Moissejev, same Publ. 15, 104,1955).

Ivanov Kholodnyi examined high dispersion spectra of several prominences (Publ.Crim.obs.18, 1957). He found that the broadening of Balmer emission cannot be explained by Doppler effect alone. Come other source of broadening should exsist to account the peculiar run of the wings. The selfreversal was evaluated and some data on the population of H and He atoms etc. in different states etc, are given.

A.B.Balkovoj found the explosion-like motions in eruptive prominence Aug.5,1951 (Publ.Crim.obs. 16, 100, 1956).

E.F.Shaposhnikova[x] described peculiar behavior and motions of eruptive filaments emerging out of spots. (Publ. Crim.obs. 18, 1957).

X) From measurement of the fluctuations of intensities in quiescent prominences E.B.Dubov found (Publ.Crim.obs.15, 1955) that turbulence in these formations can be described as isotropic with the dissipation of energy 5-10 ergs/degree sec. The Joules losses in hydromagnetic waves may be considered as a source of this dissipation.